

WHAT IS CLAIMED IS:

- 1                   1.     A power device, comprising:  
2                   a gate electrode, a source electrode, and a drain electrode provided within  
3     an active region of a semiconductor substrate of first conductivity type; and  
4                   a vertical diffusion region of second conductivity provided at a periphery  
5     the active region, the vertical diffusion region extending continuously from a top surface  
6     of the substrate to a bottom surface of the substrate, the vertical diffusion region  
7     including:  
8                   an upper portion having a first depth, and  
9                   a lower portion having a second depth that is substantially greater  
10    than the first depth.
- 1                   2.     The power device of claim 1, wherein the power device is an IGBT  
2     device.
- 1                   3.     The power device of claim 1, wherein the vertical frame is a scribe  
2     diffusion region.
- 1                   4.     The power device of claim 1, wherein the upper portion primarily  
2     comprises of an impurity of first type and the lower portion comprises of an impurity of  
3     second type different from the impurity of first type.
- 1                   5.     The power device of claim 4, wherein the impurity of first type has  
2     a first diffusion rate and the impurity of second type has a second diffusion rate, the  
3     second diffusion rate being greater than the first diffusion rate.
- 1                   6.     The power device of claim 5, wherein the impurity of first type is  
2     boron.
- 1                   7.     The power device of claim 6, wherein the impurity of second type  
2     is aluminum.
- 1                   8.     The power device of claim 1, wherein the first depth of the upper  
2     portion is less than about 70% of the second depth of the lower portion.
- 1                   9.     The power device of claim 8, wherein the first depth of the upper  
2     portion is about 50% of the second depth of the lower portion.

1           10.     The power device of claim 1, wherein the vertical diffusion frame  
2 provides forward and reverse blocking capabilities.

1           11.     A power device; comprising:  
2           a gate region, a source region, and a drain region provided in an active  
3 region of a semiconductor substrate of first conductivity type, the substrate having a front  
4 side and a backside;  
5           a scribe diffusion region of second conductivity type provided around the  
6 active region, the scribe diffusion region extending continuously from the front side of the  
7 substrate to the backside of the substrate, the scribe diffusion region comprising an  
8 impurity of first type and an impurity of second type different from the impurity of first  
9 type.

1           12.     The power device of claim 11, the scribe diffusion region including  
2 a first portion adjacent to the front side of the substrate and a second portion adjacent to  
3 the backside of the substrate, the first portion primarily comprising the impurity of first  
4 type and the second portion primarily comprising the impurity of second type.

1           13.     The power device of claim 11, wherein the scribe diffusion region  
2 provides the power device with substantially symmetrical forward and reverse blocking  
3 ratings.

1           14.     The power device of claim 11, wherein the impurity of first type is  
2 boron and the impurity of second type is aluminum.

1           15.     The power device of claim 11; further comprising:  
2           a plurality of wells of second conductivity provided within the active  
3 region of the substrate, the plurality of wells having an impurity of third type.

1           16.     The power device of claim 15, wherein a diffusion rate of the  
2 impurity of second type is greater than that of the impurity of third type.

1           17.     The power device of claim 11, wherein the substrate of first  
2 conductivity is an N type substrate, and the scribe diffusion region of second conductivity  
3 is a P type region.

1           18.     A method for fabricating a power device, comprising:  
2           providing a substrate of first conductivity, the substrate having a front side  
3           and a backside;

4           forming a scribe diffusion region of second conductivity at a periphery of  
5           the substrate, the scribe diffusion region extending continuously from the front side to the  
6           backside of the substrate, wherein the scribe diffusion region includes an impurity of first  
7           type and an impurity of second type that is different than the impurity of first type.

1           19.     The method of claim 18, further comprising:  
2           providing a peripheral impurity region at a first scribe area on the front  
3           side of the substrate, the peripheral impurity region being provided with the impurity of  
4           first type; and  
5           providing the impurity of second type at a second scribe area on the  
6           backside of the substrate.

1           20.     The method of claim 18, wherein a concentration of the impurity of  
2           first type at the peripheral impurity region is between about  $10^{19}$  to  $10^{20}$  atoms/cm<sup>3</sup>.

1           21.     A method for fabricating a power device, comprising:  
2           providing a substrate of first conductivity, the substrate having a front side  
3           and a backside;  
4           forming an aluminum structure at a scribe area on the backside of the  
5           substrate; and  
6           placing the substrate having the aluminum structure in an environment  
7           with a first temperature that is less than the melting point of aluminum to prevent the  
8           aluminum structure from melting.

1           22.     The method of claim 21, wherein the environment has oxygen to  
2           convert the aluminum structure into an aluminum oxide structure.

1           23.     The method of claim 22, wherein the environment is an inside of a  
2           furnace.

1           24.     The method of claim 23, further comprising:

- 2                    increasing the temperature of the environment to over 1000 degree
- 3 Celsius; and
- 4                    leaving the substrate within the environment until aluminum atoms have
- 5 diffused to at least a midpoint between the front and back sides of the substrate.

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